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Process of extraction of liquid of a of the aforesaid cellular material, and devices of carrying in work proceeded
The present invention relates to the field of the extraction of liquid starting from a pressed cellular material.

The cellular material pressing is used for a long time in the agro-alimentary field, for example for the juice extraction of beet pulps.

The technical one of pressing used in the industry of manufacture of sugar aims at collecting maximum liquid pressed pulps. It was noted that single mechanical pressing allowed only the obtaining of a percentage limited of liquid, and that an increase in pressure did not make it possible to obtain more the liquid one, insofar as the enclosed in the cells, or liquid portion intracellular, remains trapped by the inner membranes with cellular material. The curves of output according to corresponding time with the single process of mechanical pressing make it possible to obtain an output which reaches a maximum rapidly, for example with approximately 22.5% in the case dun pressing of beet cosettes by means of a filter presses.

It was noted that the influence of the temperature on the cell membranes pendent the diffusion deteriorated the quality of the juice collected in larger quantity, which obliges to envisage downstream from the process of pressing of the more or less complex steps of purification.

One comes to the observation that single mechanical pressing with the moderate pressures does not allow the rupture of the integrity of the cells, and constitutes an insurmountable dam with a high output of extraction. Several technical was already proposed, essentially of type chemical and biological, in order to carry out a rupture of the cells by a nonthermal process: one can quote a process implementing a very high pressure, or a purely chemical or enzymatic process.

One also sought to take as a starting point the technical by electrosmosis implementing the application of an electric field continuous by low intensity to dehydrate materials of the very various types (these technical of electrosmosis for example is described in documents EP-A-0 384.081, JP-A-06 154.797, JP-A-61 182.898 and JP-A-06 170.123). Tests were thus carried out, based on the application of an electric field continuous with the cellular material, concurrently with mechanical pressing.

These tests showed that a continuous electric field of low intensity makes it possible to increase the rate of extraction of the juice of the pressed cellular material. However, these tests carried out with continuous electric fields also put in evidence very adverse secondary effects, probably inherent with the electric heating of the material and the electrolysis of this one pendent the electric treatments of long duration. These secondary effects result in to decrease the effectiveness of the electric treatments, and deteriorate the quality of the liquid juice collected.

Lastly, one also took as a starting point technical of molecular biology aiming at supporting the absorbance of DNA by vegetal cells and/or micro-organisms and consisting to treat the cells or agglomerates with an electric field with high pulsation (preceded CEHP). It was thus proposed for the sugar extraction to carry out a sugar beet preprocessing (entire or wholesale pieces), consisting to treat them in water with impulses of electric field, so particularly accelerating the saccharose meditation. The extraction and/or pressing intervene subsequently to this preprocessing, in general after a cutting or prior grinding of beets or pieces of beets which were pretreated. This technical is described in detail in document FR-A-2 779.741.

However, this preprocessing implies a substantial pure water consumption, and requires moreover a subsequent step of treatment (for example by concentration or evaporation) to separate the liquid one to recover water used to lower electric conductivity.



The purpose of the invention is conceiving a new process of extraction of liquid of cellular material of an electromechanical type, not presenting the mentioned disadvantages and limitations, i.e. making it possible to obtain outputs of extraction raised without substantial deterioration of the physicochemical properties of liquid collected.

The process of extraction according to the invention must be able tre applicable in various fields, i.e. not only the agro-alimentary field, but also the organic or cosmetic field.

In accordance with the invention, the process of extraction of liquid consists in subjecting cellular material to the combined action of a mechanical pressing and a treatment per pulsed electric field of moderate energy applied by salvos of brief and repeated impulses high tension.

The tests carried out by the applicants indeed showed the very large superiority of the treatments by pulsed electric field of moderate energy, compared to the treatments by continuous electric field maintained pendent one substantial duration, and they could note that the combined action of mechanical pressing and the treatment by drawn electric field made it possible to very substantially increase the output of liquid collected according to time, and this without truly affecting the

chemical or physical qualities the liquid ones collected.

One had already used preprocessings by continuous or pulsed electric field, front to carry out a treatment of pressing, in processes of sugar extraction starting from entire sugar beets or wholesale pieces (see for example document FR-A-2 779.741), in processes of dehydration of the sludge coming of spent water (see for example documents US-A-5 695.650, the USA 5.893.979, and DE-A-2 627.786). In all the cases, the preprocessing and the following treatment are implemented one after the other one. The mentioned documents thus do not contain any teaching suggesting a combined action of the treatment by electric field and a mechanical pressing. Moreover, in the processes of dehydration of the spent water sludge, it was envisaged a heating of the sludge concurrently to the electric applying in order to obtain a combined effect improving desired dehydration. Gold, when one is interested, as it is the case in the frame of the invention, with the extraction the liquid ones, i.e. one wants to avoid denaturing the physical or chemical qualities the liquid one collected, one as far as possible seeks to avoid any process of heating of the cellular material, so that technical proposed dehydration would not know the transposed in the frame of research of an extraction of liquid.

The treatment by pulsed electric field can be initiated simultaneously, or in alternative subsequently to the beginning of mechanical pressing, in particular after a duration predetermined of corresponding mechanical pressing to the obtaining of a rate of liquid increasing substantially more in time. In this last case, one will be able to provide that the liquid ones obtained by single mechanical pressing, then by the mechanical pressing combined with the treatment by pulsed electric field, are collected separately. Such a selective recovery of liquid obtained by extraction of a cellular material extremement interesting in the practice, because the second liquid one is extremement collected in the frame of a deferred treatment by pulsed electric field present a very different composition of the first liquid one obtained by preliminary mechanical pressing. It was indeed noted that the second liquid one obtained was clearer and presented less impurities. In the particular case of the treatment of beet cossettes, one also noted that the second liquid one showed a higher sugar rate.

The treatment by pulsed electric field of moderate energy thus brings an elegant solution in the search of an optimal extraction of liquid without significant deterioration of the physical or chemical qualities of liquid collected, while making profitable the very short durations of applying of the pulsed electric fields which do not produce substantially electrolysis, which one could check experimentally.

In the frame of a deferred initiation of the treatment by pulsed electric field of moderate energy, one will be able to generally envisage to reiterate the treatment the obtaining of a rate of liquid increasing substantially more in time. One can thus implement successive salvos, with predetermined space of times, allowing each time to collect more the liquid one, the liquid ones optionally being collected separately for a selective recovery.

Preferably, mechanical pressing, when it is combined with the treatment by pulsed electric field, is exerted with a moderate pressure, essentially ranging between 1.105 Pa and 30.105 Pa. It was indeed noted that it was unnecessary to use pressures very high during mechanical pressing, thanks to the combined effects of mechanical pressing and the simultaneous treatment by pulsed electric field of moderate energy.

Advantageously, the field of electric pulsed is applied pendant one duration ranging between 0,1 and 10 seconds, by impulses of intensity to most equal to 15 KV/cm and of which the unitary duration is low with 500 nss.

The invention also relates to devices of carrying in work of the mentioned process of extraction, the aforementioned devices comprising of the conventional equipment especially adapt with the particular feature of the process of the based invention on the combined action of mechanical pressing and the treatment by pulsed electric field of moderate energy applied by salvos of brief and repeated impulses high tension.

In accordance with a first play mode, it is about a device of the type filters press, comprising juxtaposed plates defining between them at least a room in bordered filter lateral walls each one internally by a grid forming electrode, the volume of the aforesaid the room which can vary by the action of a membrane of pressing arranged behind of a wall. In this case, the two electrodes of or each room are connected to a source of pulsed electric field capable to send brief and repeated impulses high tension.

In accordance with a second play mode, it is about a device of the screw press type, comprising a room at filter bottom delimited by two walls forming electrodes, the volume of the aforesaid the room which can vary by the action of a pushed screw arranged behind wall.

In this case, the two electrodes of the room are connected to a source of pulsed electric field capable to send brief and repeated impulses high tension.

In alternative, it is about a device of screw press the functioning type uninterrupted, comprising at least a screw rotating in an envelope associated with bottom filtering and delimiting with this one an annulus whose volume decrease of the upstream towards the downstream. In this case, two electrodes are formed by a section of the envelope and at the very least a section of shaft of the screw compared to the said section of envelope, the aforementioned electrodes being connected to a source of pulsed electric field capable to send brief and repeated impulses high tension. One will be able to then provide that the section of envelope and the section of screw shaft are separated from remaining from the envelope or the screw shaft by insulating flanges.

In accordance with a third play mode, it is about a device of the type presses with band, comprising a room at filter bottom delimited by the superimposed portions of two bands in continuous run, each one of the aforesaid portions being bordered by a continuous web forming electrode, the volume of the aforesaid the room which can vary by the action of spacing between rollers of support associated with the said superimposed portions. In this case, the two electrodes of the room are connected to a source of pulsed electric field capable to send brief and repeated impulses high tension.

Other features and advantages of the invention will appear clearly with the reading of the description which will follow and of the annexed drawings, the aforementioned drawings illustrating different devices of carrying in work of the process of extraction according to the invention, in reference to the figures where: them figures 1 to 4 illustrate the carrying in work of the process of extraction according to the invention by means of a device of the type filters press, with of figure 1 a sight in general prospect for the device, of figure 2 a cross-section of three juxtaposed plates of Mrs. device with the

different equipment structural which is associated there, of figure 3 successive steps of the process in which the treatment by pulsed electric field is initiated simultaneously with mechanical pressing, and of figure 4 successive steps of an alternative of the process, according to which the treatment by pulsed electric field is initiated after a predetermined duration of mechanical pressing; appear it 5A illustrates out of cut the carrying in work of the process according to the invention with a device of the screw press type, by showing three successive steps of the process; appear it 5B illustrates out of cut an alternative of carrying in work by means of a single screw press functioning uninterrupted; it figure 6 illustrates out of cut the carrying in work of the process according to the invention by means of a device of the type presses with band, in accordance with a continuous process; it figure 7 is a diagram illustrating the output of extraction of liquid according to the time, obtained by carrying in work of different technical, namely the technical conventional one of single mechanical pressing (curve I), technical according to the invention with treatment by electric field pulsed initiate simultaneously with mechanical pressing (curve II), and an alternative of technical according to the invention with treatment by electric field pulsed initiate after a predetermined duration of mechanical pressing (curve III); it figure 8 is another diagram to be brought closer that of figure 7, illustrating the curve of the output obtained in the frame of a reiterated action of a pulsed electric field (curve IV).

One now will describe more in detail the different devices of carrying in work of the process of extraction of liquid according to the invention, these devices being naturally quoted that as examples, after what one will return more in detail on the particular modalities of the treatment by pulsed electric field of moderate energy.

One first of all will describe a device of carrying in work of the process according to the invention which is of the type filters press, while referring on figures 1 to 4.

On figure 1, one distinguishes machine from pressing from type filters press 10, which includes/understands in a known way in oneself a plurality of plates 11 which are juxtaposed, for example out of cast iron or polypropylene, the aforementioned plates being mounted to slide on guide rails 12 of a frame 13. Plates 11 are framed by a first plate of end 14 integral of an end of rails 12, and a second mounted plate of end 15 contrary to the plate 14 to slide on rails 12. This last plate 15 is secured on the stem of a jack 16 of which the body is integral of frame 13. One also distinguishes on figure 1 a tray from recovery 17 in which the formed cakes in the rooms of the filter are collected presses which are delimited by the juxtaposed plates 11, with fine of the process of extraction of liquid. One did not represent on figure 1 the different pipings associated with the product supply constituting the cellular mass of material which one wants to extract the liquid one, with extended of the filtrates and with liquid collected in the frame of the combined action of a mechanical pressing and a treatment per pulsed electric field of moderate energy, and with liquid of washing injected into fine of the process of extraction for the washing of the cake. One also did not represent the source of pulsed electric field to which are connected the electrodes laid out in each room of filtration, the aforementioned source being capable to send brief and repeated impulses high tension, preferably successively room after room.

On figure 2, one distinguishes three plates 11 making portion of device 10 mentioned. Each plate 11 has two concave parallel faces presenting a central cavity (the plates of end 14 and 15 do not have whereas a concave face presenting a cavity, these plates of end not being represented on figure 2). The lateral faces of plates 11 are revetues of a fabric filtering 18, so that each pair of juxtaposed plates 11 defines between these plates a room 20 in lateral walls filter 18. For each room of filtration 20, one of the filter walls 18 is in support against the lateral face of a plate presenting of the reliefs or flutes 19 being used for the drainage of liquid which crosses the aforementioned filter wall. The liquid one passing by the flutes 19 which are organized according to a communicating labyrinth, leads to passages 27 and 28 or 27' and 28' which emerge in a piping 29 commune with different rooms 20. On the other lateral face of each room of filtration 20, the filter wall 18 is in support against a flexible membrane 21 whose outer face is subjected to the action of a source of compressed air admitted by a passage of inlet 23, emerging here in a passage 24 commune run with two membranes 21 of the central plate 11. In alternative, one will be able to replace the compressed air by water under pressure. Thanks to this membrane of pressing 21 arranged behind filter wall 18, the volume of the room concerned of filtration 20 can vary.

Moreover, each lateral wall filter 18 of each room 20 is bordered internally by a grid forming electrode 22. In accordance with an essential aspect of the invention, the two electrodes 22 of each room of filtration 20 are connected to a source of pulsed electric field 40 by conducting associated 41 represented here by lines in mixed feature, the aforementioned source of pulsed electric field being capable to send brief and repeated impulses high tension in the two electrodes 22 of each room of filtration 20.

It should be noted that the two electrodes 22 remain against the filter walls 18 corresponding, i.e. the formed cake in the room of filtration 20 is enclosed between the two electrodes 22 whatever the distance separating the aforementioned electrodes, i.e. whatever the extension of the membrane of pressing 21.

One is thus capable to exert on the cellular material contained in each room of filtration 20 and confined between the two electrodes a 22 at the same time mechanical pressing and a treatment by pulsed electric field of moderate energy which is applied by salvos of brief and repeated impulses high tension.

The mechanical ordering of pressing, i.e. the ordering of compressed air (or water under pressure) operating the membranes of pressing 21, and orders it pulsed electric field of moderate energy will advantageously be managed by a central pilot (not represented here) who determines the accurate moment of intervention of each action exerted on cellular material. It will be able to prove to be interesting for this reason to envisage a mechanical member and/or electric associated with sources 40 to organize a successive emission after room room.

Advantageously moreover, one will be able to just after expect that the treatment by pulsed electric field is initiated subsequently to the beginning of mechanical pressing, i.e. the beginning, in particular after a duration predetermined of corresponding mechanical pressing to the obtaining of a rate of liquid increasing substantially more in time.

One also distinguishes on figure 2 from passages 30, 31, 32 spared in the portions of the plates with fluted walls which are contrary to the portions presenting the passages from liquid 27', 28'. These passages 30, 31, 32 correspond to extended of liquid of washing in the case of a final step of washing of the cakes thanks to fluid of washing admitted by passage 29. The fluid one of washing goes up then by passages 28', 27' (without passing by passages 28, 27 thanks to a system of valves associated not represented here) in the rooms of filtration 20, and out of spring into through the filter walls 18 and

passing by passages 32,31,30. The way of liquid of washing is thus organized into diagonal in each room 20, which guarantees an effective washing of the cakes which are there.

To produce the filter presses 10 having the structure which comes from the described one, one will be able to use the square or rectangular plates presenting drillings at the four corners to constitute passages of liquid, filtrate, and of fluid of washing, such as those carried out by the company codéposante CHOQUENET SA for filters presses of dehydration. It should be noted that the filters traditional presses of dehydration by electrosmosis are not equipped with the system previously not described of electrodes connected to a source of pulsed electric field, and that moreover the electric field, which is continuous, is exerted simultaneously in all the rooms.

Device 10 of the type filters press which comes from the described includes/understands a plurality of rooms of filtration 20, but it goes without saying one could use only one room of filtration delimited by two frames or plates juxtaposed. However, in the frame of an industrial exploitation, it will be more interesting to envisage devices comprising a large number of juxtaposed plates, in order to improve the performances of extraction. One will be able naturally to adapt other types of filters presses, for example a filter presses with suspended plates. One will be able also to envisage plates of different forms, for example circular or round.

One now will describe, in reference on figure 3, the successive steps of carrying in work of the process of extraction of liquid according to the invention. On this figure, one took again on a reduced scale the illustrated structure of figure 2 and described in higher detail.

In A), it is a question of a preliminary step of food of the rooms of filtration 20 in order to constitute a cellular material cake which one wants to extract the liquid one. In this case, the liquid product concerned is allowed under pressure by piping 25 to penetrate by passages 26 in each room of filtration 20. The supply pressure forces the liquid one to run out through the filter walls 18, the filtrate passing then by passages 27,28 or 27', 28' to emerge in piping 29. The solid particles, too large to pass through the meshes filter walls 18, are retained in each room of filtration 20 and form a cake. The mass of the cellular material cake then is perfectly confined between the two electrodes 22 which are preferably produced in the form of metallic grid.

In b), compressed air (or in alternative of water under pressure) is admitted by passages 23,24, and acts on the rear face of flexible membranes 21 to compress the cake noted 50 which is confined between the two electrodes facing 22. Concurrently to the mechanical pressing carried out by flexible membranes 21, source 40 of pulsed electric field of moderate energy sends to the two electrodes 22 salvos of brief and repeated impulses high tension, the electrodes of each room being to potentials of opposite signs. One thus generates in the cellular material of cake 50 a pulsed electric field of moderate energy which causes to carry out the desired action, i.e. a perforation of the membrane and/or a widening of the pores for all the cells of cellular material. This action is immediately carrying with profit by the combined action of mechanical pressing. This was never the case in the technical former ones based on a preprocessing by electric field, followed sometimes a long time after a mechanical pressing: the explanation of this phenomenon could lie in the rapid contracting of certain membrane pores once the applying of the pulsed electric field ceased.

The liquid extract passes by passages 27,28 or 27', 28' and can be recovered by the common piping 29. As it thereafter will be seen, the percentage of recovery of liquid obtained by the carrying in work of this process with combined action of mechanical pressing and treatment per pulsed electric field of moderate energy is very upper with the percentage obtained by the single action of a mechanical pressing.

At the end of the process of extraction of liquid, one can carry out a washing of the cake in each room of filtration 20. This step is illustrated into c).

The liquid one of washing for example is admitted by piping 29, and goes up by passages 28', 27' (without passing by passages 28,27), in the rooms of filtration 20, the liquid one of washing finally escaping by the network from passages 32,31,30 mentioned. In alternative, the direction of liquid of washing will be able to be reversed, into incoming by passage 30, and into outgoing by piping 29. One can then proceed to the opening of the filter presses, and carry out a débitissage remaining cake by manual operations or mechanized. Such operations are conventional in the frame of the traditional use of the filters presses of dehydration.

On figure 4, one illustrated an alternative of the process of extraction which comes from the described.

The step has) is similar to the preceding one, and this step corresponds to the power supply of the filter and the formation of the cake.

Then, one noted b)) a step of pre-pressing and pre-comptactage of the cake, without electric field applying pulsed. In other words, one then carries out the first mechanical pressing by action of compressed air on the rear face of flexible membranes 21, which makes it possible to collect by piping 29 liquid noted L1. This step b)) actually corresponds to a step of conventional mechanical pressing, and it is known well that the output according to time arrives enough rapidly at a substantially constant percentage, i.e. the rate of liquid obtained does not believe substantially any more in time.

At this point in time one implements the treatment by pulsed electric field of moderate energy as illustrated in b2). Of course, this treatment by pulsed electric field is implemented concurrently at the action of the mechanical pressing which is maintained, with Mrs. pressure of applying. Such a combined action makes it possible to collect liquid noted L2 by the piping from extended 29.

Like that was said higher, one will be able to provide that liquid L1 obtained by single mechanical pressing, and liquid L2 obtained by a mechanical pressing combined with the treatment by pulsed electric field, are collected separately. Such a selective recovery will be able to prove very interesting in the agricultural or food field, particularly in the frame of the extraction of the juice of beet pulps. Indeed, the tests showed that second liquid thus obtained (L2) the present one a very different composition of the first liquid one obtained by single mechanical pressing (L1). It was in particular noted, in the case of the extraction of the beet juice, that liquid L2 presented a percentage of saccharose substantially higher, and that this liquid L2 was also clearer, therefore charged with impurities, and purer than liquid L1.

After the step b2), one will be able according to case's to proceed to a step of washing of each cake, such as the illustrated

step c) of figure 3 and previously described. Such a step of washing is certainly beneficial, but at all does not constitute an obligation in the frame of the carrying in work of the process according to the invention.

In all the case, the applying immediate, or more or less deferred, of pulsed electric field of moderate energy will be organized by salvos of brief and repeated impulses high tension. This principle is basically different conventional applying of a continuous electric field making the object of technical former mentioned. Thanks to the applying pendent one very short duration of a very high tension, one substantially manages to avoid any phenomenon of electrolysis, which one could check experimentally. One can thus affirm that the liquid one thus extracted cellular material is substantially not degraded, which constitutes an advantage coming still to be added to the increase of the output according to time.

One will be able in alternative to provide that the step b) of figure 3, or the step b2) of figure 4, is reiterated at least once. One then implements a treatment by pulsed electric field which is reiterated with the obtaining of a rate of liquid increasing substantially more in time. The successive salvos of brief and repeated impulses high tension then make it possible still to increase the output of liquid extracted. One will be able also to envisage whereas the liquid ones obtained with each treatment by pulsed electric field are collected separately. One will reconsider further this phenomenon in reference to the diagram of figure 8.

Moreover, one will be able to also envisage the carrying in contact of the pressed layer with a solvent, followed by a solvent extraction aqueous solution of the pressed layer, and the extraction by pressing of the solution. This operation will be able to be naturally repeated one or more time.

One now will describe, in reference to the figure 5A, another device of carrying in work of the process of extraction according to the invention, the device being then of the screw press type.

One thus distinguishes a device from the screw press type 110 comprising an housing 111 with a feed hopper 112. A screw of food 113 is mounted rotating in the room of food in which hopper 112 emerges, room whose bottom 116 is filter to recover the filtrate concerned which is compressed by the screw of food 113 against a bivalvular wall 115. Other side of wall 115, it is envisaged a screw of compression 121 which is coupled with a sliding shaft inside the shaft of the screw of food 113, and is requested by an hydraulic system of impulse 114.

One finds then a room of filtration 120 at bottom filtering 118, which is now delimited by two walls forming electrodes 122. The cake thus confined between two electrodes 122 is noted 150, and the volume of the room of filtration 120, which corresponds to the cylinder delimited by the discs forming electrodes 122, in support respectively against the end of the screw of compression 121 and one door from extended 117, is variable by actuate hydraulic system 114.

In A), it is about the preliminary step of formation of the cake 150, which is to be brought closer the step) previously described for a device of the type filters press.

In accordance with an essential feature of the invention, two electrodes 122 of room 120 are connected to a source of drawn electric field 140 capable to send brief and repeated impulses high tension.

Thus in b1), one subjects cake 150 to the action of single mechanical pressing. This makes it possible to collect first liquid through L1 the bottom filtering 118 of room 120.

In b2), one subjects the cake to the combined action of mechanical pressing, and a treatment per pulsed electric field of moderate energy, by applying a salvo of brief and repeated impulses high tension, thanks to the source of pulsed electric field 140. This makes it possible to recover new liquid L2. As previously, recoveries of liquid successive which were extracted can be organized in a selective way.

One will have included/understood that device 110 of the screw press type makes it possible to implement the process of extraction of liquid according to the invention in its different play modes, i.e. a treatment by electric field pulsed initiate shortly after the beginning of mechanical pressing, or a treatment by electric field pulsed initiate after a duration predetermined of corresponding mechanical pressing to the obtaining of a rate of liquid increasing more in time, or a treatment by pulsed electric field reiterated as of the obtaining of a rate of liquid increasing substantially more in time after the first step of treatment by pulsed electric field.

On the figure 5B, one illustrated an alternative of carrying in work, by means of a screw press of a slightly different type of that of the figure 5A.

The device of the screw press type, noted 110', comprises an housing 111' formant wraps for a screw here single 121'. This screw 121' is mounted on a screw shaft 114' of frustoconical form (axis noted X), cest-with-statement of increasing diameter progressively of the upstream (feed hopper 112') towards the downstream (led the extended one of the pressed cake 117'). The conveyed material is thus progressively pressed, and the liquid one obtained is collected after crossed bottom filtering 118' of envelope 111', in a low collector 128'. Screw 121' is rotated by a group mounted motor reducer 116' on frame 115' of the device.

Two electrodes are formed for the application of an electric field pulsed by the source of pulsed electric field 140.

Contrary to the known screw presses used in the technical ones of electrosomosis, where the electrodes are consisted all the length of the shaft of the screw and the envelope, the electrodes are formed here by a section 122'. 1 of envelope 111' and by the very least a section 122'. 2d' shaft 114' of the screw compared to the said section of envelope, the aforementioned electrodes being connected to the source 140 which is capable to send brief and repeated impulses high tension. This makes it possible to have a reasonable dimensioning of the supply means electric.

In the species, single the section of screw shaft 122'. 2 is connected (by nonvisible inner means here) to source 140. Sections 122'. 1 and 122'. 2 are then preferably separated from remaining from envelope 111' or shaft 114' from screw by insulating flanges electrically respectively 123'. 1 and 123'. 2. The portion concerned of the annulus 120' thus corresponds to the room of applying combined of mechanical pressing and the pulsed electric field.

One now will describe a third device of carrying in work of the process of extraction according to the invention, which is of the type presses with band, in reference on figure 6.

One thus distinguishes a device from the type presses with band 210 comprising two bands 218,219 in continuous run, band 218 being made up by a filter support. Band 218 is tensioned between rollers of end 211 and passes on an intermediate roller 216, one of rollers 211 being motorized. Band 219 as for it is maintained between rollers of end 213, of which one is also motorized in synchronism with the movement of mentioned motorized roller 211, and passes on an intermediate roller 217. Superimposed portions of two bands 218,219 pass on rollers of support respectively 212 and 214, whose spacing decreases in the direction of the run of the two bands. These superimposed portions delimit a room 220 which is thus at bottom filtering 218, and this throughout the continuous run of two bands 218,219. The volume of room 220 can vary by the action of spacing between the rollers of support 212,214 associated the said superimposed portions.

It moreover is provided that each superimposed portion is bordered by a continuous web forming electrode 222 passer by on associated rollers 215.

In accordance with an essential feature of the invention, two electrodes 222 of room 220 are connected to a source of pulsed electric field 240 capable to send brief and repeated impulses high tension. It is to be noted that the portions of the bands 218,219 who are concerned with two electrodes 222 have a very low length compared to the remaining portion of the aforesaid bands: this is there still interesting for an applying of the pulsed electric field which is limited to these single zones, authorizing low-size supply means electric.

The process of extraction is then carried out uninterrupted thanks to the run of the two bands with superimposed portions 218,219. The portions of cellular material which one wants to extract the liquid one are allowed with the level of the inlet E of device 210, and a filtrate runs out through low band 218. The rollers upstream 212, 214 can carry out a mechanical pressing by reduction in the thickness of the room of filtration 220. Once the cake noted 250 arrives plumb with electrodes 222, the material is subjected to the combined action of mechanical pressing and a treatment per pulsed electric field of moderate energy applied by salvos of brief and repeated impulses high tension, thanks to the corresponding source 240. This then makes it possible to recover liquid additional downstream from the electrodes in run 222.

With the exit of this process of extraction, one recovers with the level of the extended S of the blocks of cake which one extracted the largest portion of liquid intracellular and extracellular.

The effectiveness of the process of extraction of liquid according to the invention, which can be implemented by one or the other one of the devices previously described of the type filters press, screw press or press with band, or by very other equivalent device, is carrying in evidence by the diagrams of figures 7 and 8 which one now will describe.

On figure 7, one represented curves of output R (in pourcents) according to time T (in minutes). The curve (I) illustrates the output of the extraction according to time for a traditional process limited to the single action of the mechanical pressing started at one moment T1. It is noted that the output R believes rapidly starting from a point Al, then grows asymptotiquement towards a limit value, which is about 22,5 W in the case of a pressing of beet cosettes using a filter presses.

The curve (II) corresponds to a combined action of a mechanical pressing and a treatment per pulsed electric field of moderate energy, the aforementioned electric field being initiated just after the beginning of mechanical pressing with moment T1. One then reaches in conditions Mrs. an output near of 50%, which corresponds to double of the output obtained by single mechanical pressing.

It is noted also that this output does not believe substantially any more in time as from one moment t2.

It appears thus interesting to use a treatment by electric field after pulsed initiate a duration of corresponding mechanical pressing to the obtaining of a rate of liquid increasing substantially more in time. This made the object of the curve (III) the first R1 portion corresponds to single mechanical pressing between moments T1 and t2, of point Al up to the A2 point, pulsed follow-up of the application of an electric field of moderate energy with the moment t2, which causes to produce a very sensitive growth of the output to reach a final value of about 78,5, in accordance with the section of R2 curve.

The diagram of figure 8 illustrates the reiterated use of salvos of brief and repeated impulses high tension.

At the moment T, one subjects cellular material to the single action of a mechanical pressing, and one obtains a section of active R1 curve of point Al at the A2 point. At one moment t2, one subjects material to a first salvo of brief and repeated impulses high tension, which causes to produce a new growth starting from the A2 point, in accordance with the section of R2 curve. Then, to one moment T3 chosen at the moment when the rate of liquid does not believe substantially any more in time, one proceeds to a new salvo of brief and repeated impulses high tension, which corresponds starting from the A3 point with the section R3, with an obtaining of an output even higher of liquid in time.

As regards the operating conditions, one will indicate precise details as an indication, being understood that these conditions will be able to vary from one material to the other one.

Mechanical pressing, when it is combined with the treatment by pulsed electric field, will preferably be exerted a moderate pressure. The tests carried out by the applicants indeed put in evidence that it was unnecessary to envisage a very high pressure, and that one obtained a very satisfying result with a moderate pressure.

In the practice, this pressure essentially will be included/understood between 1.105 Pa and 30.10.5 Pa.

Preferably, the pulsed electric field will be applied pendant one duration ranging between 0.1 and 10 seconds, by impulses of intensity to most equal to 15KV/cm and of which the unitary duration is low with 500 ys.

Tests carried out by the applicants made it possible to put in evidence which the essential parameters were the intensity of the impulses, as well as the duration and the number of the impulses of high tension.

With a filter presses on scale of laboratory, one noted that, for an electric field of 2 KV/cm and with one unitary duration of the impulses increasing slightly (from 10 to 500 ys), the output passed respectively from 60 to 78%, but that beyond 500 Acs the output is substantially constant.

As regards the number of pulse successive, one noted that one obtained interesting results starting from a hundred impulses, and that the output passed from approximately 62 to 72 T up to 1000 impulses. Audelà of 1000 impulses, the output is substantially constant, so that it is unnecessary to continue the salvos of brief and repeated impulses.

As regards the intensity of the impulses of high tension, the tests showed that a value ranging between 1,2 and 2 KV/cm gave good results, but which one could go up to a value of 15 KV/cm. Generally, the pulsed field electric will lie between 100 volts per centimetre and 15 Kv per centimetre, which corresponds to a pulsed electric field " of moderate energy ".

The process of extraction of liquid according to the invention will be able tre applied with cellular materials extrmement varied, and one can quote on a purely nonrestrictive basis the vegetal ones (oleaginous beets, apples, sprues, seeds, etc), and the micro-organisms.

The invention is not limited to the embodiments which come from tre described, but includes on the contrary any alternative beginning again with equivalent means, the stated essential features higher.